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Using an Online Numeracy Practice Test to Support Education Students for the Numeracy Component of the LANTITE

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Abstract: In Australia, teacher education students must pass the Literacy and Numeracy Test for Initial Teacher Education (LANTITE) to meet accreditation requirements. Although this has been mandated since 2016, there are currently few resources available for students to use in preparation for the test. To help students prepare for the numeracy component of the LANTITE, we developed an online Numeracy Practice Test (NPT) through the institution's learning management system. This study assessed the learning analytics from the NPT between students who subsequently passed the numeracy component of the LANTITE with those that failed. Our results show that students who passed performed significantly better in the NPT, had fewer attempts, spent less time on the NPT, and accessed it closer to the date of the LANTITE, which demonstrate students' ability to self-assess the level of support required.

Introduction

The importance of teacher effectiveness, including their personal literacy and numeracy skills and ability to teach these skills, and its impact on students' achievement of learning outcomes is well documented (Darling-Hammond, 2000, Hattie, 2009; Rowe, 2003; Shirvani, 2015; Stronge et al., 2011; Tchoshanov et al., 2017). This importance was made prominent in Australia by the Teacher Education Ministerial Advisory Group in 2014, which recommended that the Australian Government mandate teacher education students (TES) to demonstrate achievement of a standard level of personal literacy and numeracy in order to become registered primary and secondary school teachers. In 2016, the Australian Government adopted this recommendation, mandating that all TES must pass the Literacy and Numeracy Test for Initial Teacher Education (LANTITE).

The LANTITE is administered by the Australian Council for Educational Research (ACER) and assesses whether TES possess a personal literacy and numeracy level broadly equivalent to the top 30% of the Australian adult population (ACER, 2016). The test is a computer-based test. There are four test windows per year. Each test window has a length of

approximately two weeks. TES can register to sit both the literacy and numeracy components of the test in a particular test window or to take them separately. The time permitted for each test component is 2 hours (ACER, 2020).

To-date, there has not been any study conducted to determine the characteristics of students who are likely to pass the LANTITE or any other similar standardised test for TES internationally. To address this gap in the research literature, we evaluated TES' performance and learning habits via an online, non-compulsory numeracy test that was developed in-house based on ACER's LANTITE Assessment Framework (2017). Being able to accurately identify TES who are likely to pass or fail the LANTITE is essential for initial teacher education providers to offer targeted and timely support.

The Numeracy Component of the LANTITE

There are 65 questions in the numeracy component of the LANTITE, of which 52 questions permit the use of an on-screen calculator (Section 1) and the remaining 13 questions do not (Section 2). Backtracking within each section is permitted but not between sections. In other words, progression into Section 2 would mean it is no longer possible to go back to Section 1 questions. All the questions are either multiple-choice or require a short response (usually requiring only a word or number). Marks are not deducted for incorrect responses (ACER, 2020).

As reported by ACER (2016), the numeracy component of the LANTITE assesses three numeracy content areas, namely: Number and Algebra (N&A), Measurement and Geometry (M&G), and Statistics and Probability (S&P). These content categories match the mathematics content strands in the Australian Mathematics Curriculum (Australian Curriculum, Assessment and Reporting Authority [ACARA], n.d.). In addition, the questions span three mathematical processes, namely: identifying mathematical information; applying mathematical knowledge and processes; and interpreting, evaluating, communicating and representing mathematics (ACER, 2016).

The test assesses numeracy in three context domains, namely: numeracy used in everyday life, numeracy used in the workplace, and numeracy used specifically in education (ACER, 2016). The difficulty of the questions is benchmarked to the Australian Core Skills Framework (ACSF), which was developed by the Australian Government as a multi-purpose adult learner skills level framework (Commonwealth of Australia, 2012). The questions in the numeracy component of the LANTITE span levels 2-5 of the ACSF (ACER, 2016). Table 1 summarises the composition of the test based on the mathematics content area, processes, context domains, and ACSF levels as published by ACER (2016).

To-date, resources available for TES to use to prepare for the numeracy component of the LANTITE continue to be scarce. At the onset of the LANTITE, ACER published a sample set of 10 numeracy questions (ACER, 2015). Of these sample questions, eight were for the calculator section of the test and two were for the non-calculator section of the test. Answers to the questions were provided without any worked solution or explanation. In July 2017, ACER published another set of 30 practice questions, which contained 24 calculator questions and six non-calculator questions (ACER, 2017a). At the same time, ACER published a document entitled: Described Proficiency Scale for the LANTITE, which explained the skills assessed by the LANTITE and how each candidate's overall result is determined (ACER, 2017b). There were 12 sample questions included in this document that

were used to illustrate the level of proficiency required to correctly answer the questions, which could have been used as preparation material. Given that this document resides in the Results section of the LANTITE website, it is unlikely that candidates would have encountered this while preparing for the test. Although these resources from ACER gave TES a sense of the type and style of questions to expect, it lacked the usefulness of having a full sample paper with an accompanying explanation of the solutions.

Category	Sub-Category	Proportion (%)
Content Areas	N&A	40-50
	M&G	20-30
	S&P	25-35
Processes	Identifying	15-25
	Applying	50-60
	Evaluate and communicate	20-30
Context Domains	Personal	45-55
	Workplace	10-20
	Education	30-40
ACSF	Level 5	5-15
	Level 4	35-45
	Level 3	35-45
	Level 2	5-15
	Level 1	0

Table 1. Proportions of questions in the numeracy component of the LANTITE based on mathematics content area, processes, context domains and ACSF levels.

More recently, ACER publicised a set of 35 retired questions (28 calculator and seven non-calculator questions) that are no longer used in the LANTITE, as well as a full sample paper with worked solutions and information on how to interpret the results (ACER, 2019a; ACER, 2019b; ACER, 2019c). The full sample paper includes test information and instructions that mirror the actual LANTITE and for the first time provides clarity on how the test looks. However, once TES complete these sample questions from ACER there are few additional resources available that are specific to the Australian context.

To address this issue and help TES prepare for the LANTITE, we developed the Numeracy Practice Test (NPT) based on ACER's LANTITE Assessment Framework (2017). The NPT is hosted on the institution's Learning Management System (LMS), Blackboard, and is available to all initial TES enrolled at the institution.

The aim of this study was to evaluate trends in students' learning analytics captured in the LMS and compares students who passed the numeracy component of the LANTITE with those who failed. Findings from this study provide information on the characteristics of TES who are likely to pass and those who are at-risk of failing the numeracy component of the LANTITE.

Literature Review

Mathematics and Numeracy Tests for Initial TES

Although the LANTITE is relatively new in Australia, standardised testing of TES have been conducted in the United States (US) since the 1980s. Unlike the LANTITE, which is nation-wide, each state in the US has its own requirement. For example, in California, all TES must pass the California Basic Educational Skills Test (CBEST), which covers reading, writing and mathematics. The mathematics component of the CBEST assesses three broad areas: estimation, measurement, and statistical principles; computation and problem solving; and numerical and graphic relationships (Commission on Teacher Credentialing, 2007). Similarly, many other states including Alabama, Florida, Georgia, Illinois, Michigan, Minnesota, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, and Washington have all developed their own tests for entry into initial teacher education and/or teacher accreditation (see for example, the Washington Educator Skills Tests (2021)). These state-specific tests are generally administered by the Educational Teaching Service (ETS) or Pearson Education, who also administer the popular test series, Praxis and National Evaluation Series (NES), respectively.

The Praxis tests are used by many US states. They cover general skills such as reading, writing, and mathematics, as well as pedagogy and discipline-specific content knowledge. The Praxis has two series of tests, Praxis I and Praxis II. The Praxis I: Pre-Professional Skills Tests, now known as the Praxis: Core Academic Skills for Educators (or simply "Praxis Core") is made up of three tests: a reading test, writing test, and mathematics test (ETS, 2020). These tests can be taken together or separately and are generally taken to gain entry into an initial teacher program. The Praxis II tests assess knowledge of specific disciplines based on the TES' teaching areas and are taken as part of the teacher certification process (ETS, 2020). Primary TES are required to take the Praxis Elementary Education: Content Knowledge for Teaching Tests, which is made up of four tests: a reading and language arts test, mathematics test, science test, and social studies test. Secondary TES take the Praxis Subject Assessments, which assesses discipline-specific content and pedagogical knowledge as well as general pedagogy (ETS, 2020).

Another popular test conducted in the US is the NES. Like the Praxis tests, the NES is a series of tests that is grouped into Essential Academic Skills tests (reading, writing, mathematics, and technology literacy) and Professional Knowledge for primary or secondary TES. In contrast to the Praxis, the NES has additional tests based on whether the TES is seeking certification in early childhood and primary school teaching, middle school teaching, or secondary school teaching. There is also an additional set of tests for Kindergarten to Year 12 teachers (Pearson Education, 2020).

In the United Kingdom (UK), core professional skills test for TES have been conducted for nearly two decades. TES must pass the Professional Skills Tests (PST) in order to register as a qualified teacher since 2000. Initially, the PST included a literacy skills test, a numeracy skills test, and an information and communications technology (ICT) skills test. In 2012, the ICT skills test was removed and the PST became a pre-requisite for entry into an initial teacher education program rather than a teacher registration requirement (Department for Education [DfE], 2011). The numeracy test is 48 minutes in duration and has two sections, a mental arithmetic and a written section. The mental arithmetic section is an audio test with 12 questions that are individually timed. This section does not permit the use of a calculator and requires TES to select one or more answer from a list. It cover topics such as

basic arithmetic, financial mathematics, fractions, decimals, percentages, proportions, measurement and conversion of units (between different currencies and between fractions, decimals, and percentages) (DfE, 2015). The written section permits the use of an on-screen calculator and involves interpreting and using data, and solving arithmetic problems (DfE, 2015).

As of April 2020, new entrants into teacher education in the UK are no longer required to complete the PST. Their abolishment was publicised as a strategy to boost recruitment by removing barriers to entry into the teaching profession (DfE, 2020a). The onus is now placed on education program providers to assure that graduates meet the benchmark for fundamental literacy and numeracy skills (DfE, 2020b). Given that the LANTITE is closely modelled on UK's PST, it will be interesting to see whether this will ultimately affect the LANTITE.

Interestingly, in March 2020, Ontario became the first province in Canada to implement a Mathematics Proficiency Test that TES must pass in order to achieve teacher certification (Ontario College of Teachers, 2020). The driver for introducing the test in Ontario is due to an ongoing decline in the number of primary school students who are able to meet the provincial mathematics standards (Ng, 2021). Unlike the numeracy component of the LANTITE and PST, which assesses mathematics content knowledge, Ontario's Mathematics Proficiency Test assesses mathematics content and pedagogy. The mathematics content component of the test is based on Year 3-9 level mathematics and makes up 70% of the test. The first five questions do not permit the use of a calculator and focus on number sense. The remaining 45 questions permit the use of an on-screen calculator and cover number sense, relationships and proportional reasoning, and measurement (Education Quality and Accountability Office, 2020). The pedagogy component of the test assesses TES' general understanding of the mathematics curriculum; planning, assessment and evaluation practices; and strategies to engage all learners (Education Quality and Accountability Office, 2020). In order to pass the Mathematics Proficiency Test, TES must achieve at least 70% in both the content and pedagogy component.

Although standardised testing of TES' numeracy occurs globally, there has been no peer-reviewed publication on these tests. This is because the tests are administered by private or government organisations that only reports on trends in test performances. Details of the tests are often shrouded in mystery.

Given the limited information on the standardised tests for TES, scholars have focused on TES' experience and perception of the tests (Bennett, McWhorter, & Kuykendall, 2006; Childs, Ross, & Jaciw, 2002). Scholars have also investigated how and how much TES were preparing for the tests (Wilder & Stricker, 1998). Surprisingly, Wilder and Stricker (1998) found that TES did little to no preparation for the test. In follow-up studies to determine the reasons why TES were not preparing, Stricker and Wilder (2001; 2002) found that TES either felt confident they would pass the test and therefore did not need to prepare or were unaware of where or how to access preparation material.

Online Practice Tests

Amongst the tests for entry into an education program or teacher certification in the US, Canada and in the UK (when the tests were being conducted), online practice tests and preparation material were provided by the test administrators (see for example

https://www.ets.org/praxis/prepare). In the US, Praxis collaborated with Khan Academy, an online learning platform, to provide a free official Praxis Core preparation course (Khan Academy, 2020). Similarly, TES preparing for the new Ontario Mathematics Proficiency Test can also access a free online practice test that mirrors the actual test. Given that it was publicised that the Ontario test was based on content from their Year 3-9 mathematics curriculum, it is possible for TES to review these curriculum in preparation for the test.

In contrast, access to the online practice test for the LANTITE is only available to registered candidates. Although the ACER LANTITE Assessment Framework and the growing pool of official practice LANTITE questions is beginning to shine light on the question type, the difficulty and the test format, there remains uncertainty about how TES can study for the test and/or how institutions can support TES' preparation.

Method

Numeracy Practice Test (NPT)

The design of the NPT was based on ACER's LANTITE Assessment Framework (2017). This was used to inform the style, difficulty, and types of questions. The latter includes the proportion of questions based on the three mathematics content area, whether they permit the use of a calculator or not, and the context domains. Four pools of questions were developed on the Blackboard LMS via the quiz feature of the LMS. The first three pools of questions were distinguished by the mathematical strand that they assessed and permitted the use of a calculator. The fourth pool comprised non-calculator type questions, covering all three mathematical strands. In total, there were 273 questions. A breakdown of the number of questions for each pool is shown in Table 2.

The test was made up of 40 randomly selected questions, 10 from each of the four pools. At the start of the test, students were notified that they could use a calculator for the first 30 questions. Questions are presented one at a time and backtracking is permitted. At the completion of the 30th question, a prompt appears to instruct students that the remaining 10 questions should be completed without using a calculator. It needs to be admitted here, that it is impossible to know whether students complied with this instruction or not. Students were also instructed to complete the NPT within 75 minutes and were provided a timer to keep track. However, students could continue the test past this time allocation.

At the completion of the test, students were shown their score out of 40, which questions they answered correctly or incorrectly, and feedback for each question. For correct responses, a brief praise was offered (e.g., "well done"). For incorrect responses, feedback provided full worked solutions and/or specific points to notice about the question (e.g., checking that the units of measurement in the drawing are all the same).

The NPT is purely optional and reside in the "Community Sites" on the LMS. It is available to all students enrolled in an initial teacher education program at the institution and is not associated with any unit of study. Students can attempt the test an unlimited number of times throughout their degree.

	Content Area	Topics	No. of Questions	Total
Calculator	N&A	Basic arithmetic	22	79
		Fractions	7	
		Decimals	9	
		Percentages	7	
		Rates and ratios	15	
		Algebra	9	
		Financial maths	10	
	M&G	Estimating, converting and reading	18	64
		Time and timetabling	12	
		Distance and perimeter	7	
		Area	7	
		Capacity and volume	6	
		Angles	7	
		Space, shape and symmetry	7	
	S&P	Interpreting data	30	61
		Statistics	12	
		Combinations	6	
		Probability	13	
Non-Calculator	All	All	69	69
			Total	273

Table 2. Number of questions in the NPT pool of questions.

Data Collection and Analysis

Learning analytics data were captured between March 2018 and October 2020 through the institution's LMS, Blackboard. Data was collected for every attempt, which include students' name and identifier, the questions administered, students' responses, and the score for each question. Blackboard provides five categories for displaying students' NPT performance: first score, last score, lowest score, highest score, and average score. Usage information such as the date of access, number of test attempts, and the duration spent on each attempt was also captured.

Purposive (criterion) sampling was used in this study. Specifically, only students who registered a score of one or more in the NPT and subsequently sat the numeracy component of the LANTITE were evaluated in this study. Overall, 159 students met these criteria. Of these students, 90% passed the LANTITE (n=143) and 10% failed (n=16). Learning analytics from the NPT for these 159 students were grouped by their LANTITE results and compared.

Data was cleaned and processed using Microsoft Excel 2016 and then analysed with IBM SPSS Statistics v26. Each dataset was initially assessed for normality using the Shapiro-Wilk test, which rejected the null hypothesis (p<0.0001 for all datasets). Therefore, a non-parametric Mann-Whitney U test was used to determine statistical significance. Given the presence of outliers in the data, we presented the median and interquartile range (IQR) rather than the mean and standard deviation. In the box plots, dots represent outliers that are more than 1.5×IQR from the lower or upper quartile and triangles represent outliers that are 3×IQR from the lower or upper quartile.

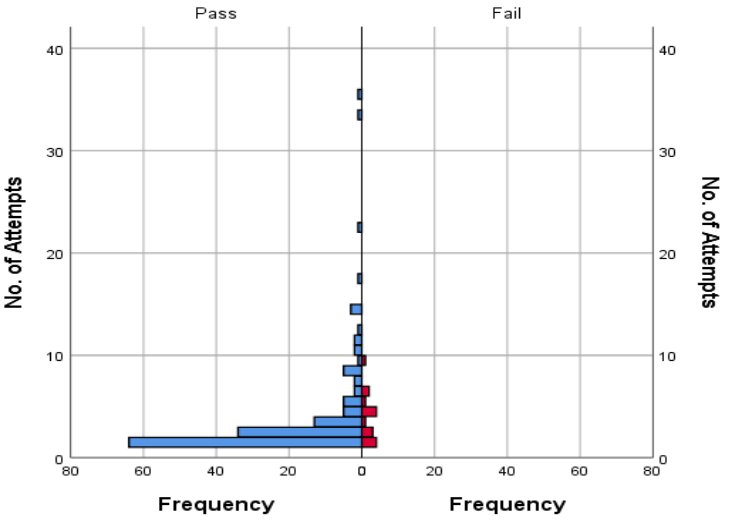
Results

In total, there were 549 attempts at the NPT, with individuals having between 1-35 attempts. Analysis of students' usage of the NPT showed that 42.8% of students had only attempted the NPT once prior to sitting the LANTITE. 23.2% of students attempted the NPT twice and 8.8% attempted it three times. A further 19% of students attempted the NPT between 4-10 times, and the remaining 6.2% attempted it more than 10 times (Tab. 3).

No. of Attempts	N	Percent	Cumulative Percent
1	68	42.8	42.8
2	37	23.2	66.0
3	14	8.8	74.8
4	9	5.7	80.5
5	6	3.8	84.3
6	4	2.5	86.8
7	2	1.3	88.1
8	5	3.1	91.2
9	2	1.3	92.5
10	2	1.3	93.8
11	2	1.3	95.1
12	1	0.6	95.7
14	3	1.9	97.6
17	1	0.6	98.2
22	1	0.6	98.8
33	1	0.6	99.4
35	1	0.6	100
Total	159	100	-

Table 3. The number of attempts students had in the NPT prior to sitting the LANTITE.

The data was then divided into two groups based on whether students passed or failed the LANTITE in order to determine the differences between these groups. In doing so, we observed approximately 45% of students who passed the LANTITE had only one attempt at the NPT prior to sitting the LANTITE (Fig. 1). In contrast, the modal number of attempts for students who failed were 1 and 4 attempts, each representing 29% of the group. On average, students who passed the LANTITE attempted the NPT fewer times than students who failed, with a median of 2 compared to 3.5, respectively.

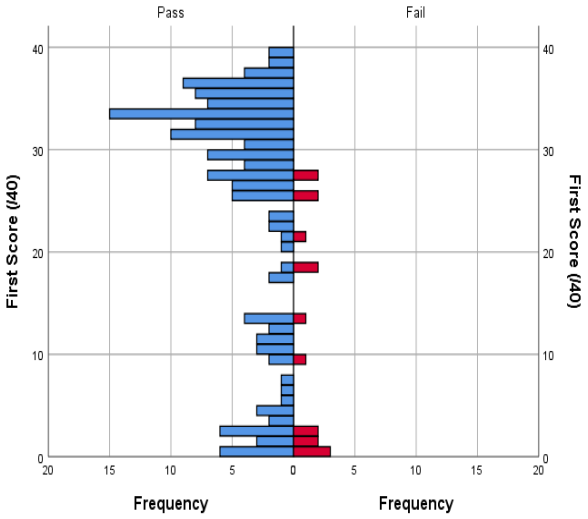


	Pass	Fail
Median	2	3.5
IQR	2	4
Max	35	9
Min	1	1

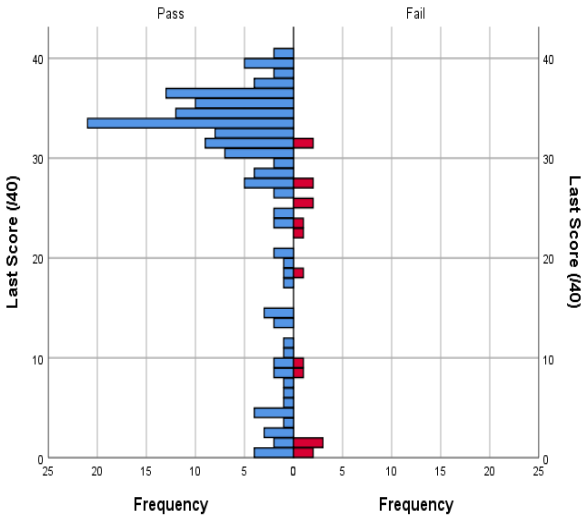
Figure 1. The number of attempts at the NPT based on whether students passed or failed the LANTITE.

We then evaluated the spread of students' scores in the NPT based on the five Blackboard measures of overall performance – students' first score, last score, lowest score, highest score, and average score. In terms of students' first score, 72% of students who passed the LANTITE achieved 20 or more (out of 40) in the NPT (Fig. 2A, blue bars). In contrast, only 31% of students who failed the LANTITE achieved 20 or more in the NPT (Fig. 2A, red bars). In fact, the majority of students who passed the LANTITE also achieved 20 or more in the NPT when categorised by their last score (78%), lowest score (55%), highest score (89%), and average score (77%) (Fig. 2, blue bars). In contrast, students who failed the LANTITE only scored 20 or more in the NPT based on their highest score (Fig. 2, red bars).

A



B



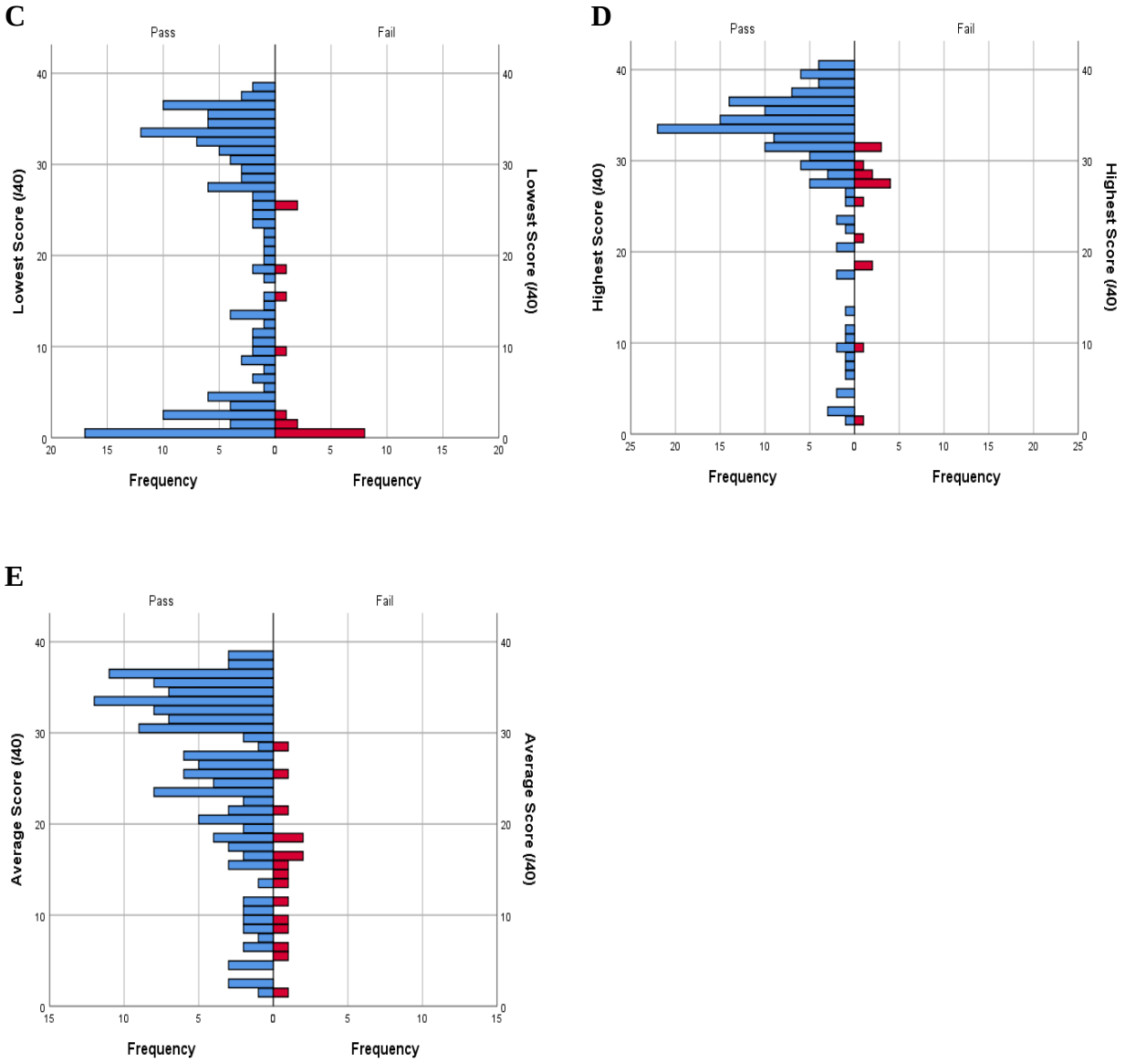


Figure 2. Spread of performance in the NPT based on student's first score (A), last score (B), lowest score (C), highest score (D) or average score (E).

Given the substantial difference in spread of NPT results between students who passed the LANTITE and those that failed, we assessed the summary statistics in order to better gauge the difference between the groups. Our data shows that students who passed the LANTITE had a higher median and maximum score in all five NPT score categories (Fig. 3 & Tab. 4). A non-parametric Mann-Whitney U test for two independent samples shows that data in all five NPT score categories were significantly different between students who passed the LANTITE and those that failed (p<0.0001 for all categories).

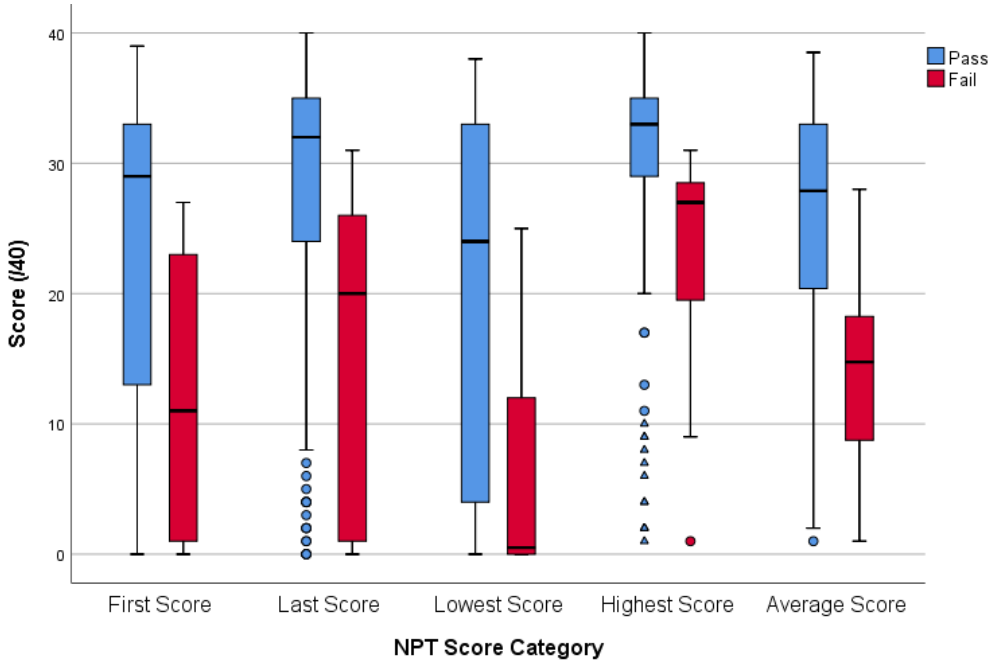


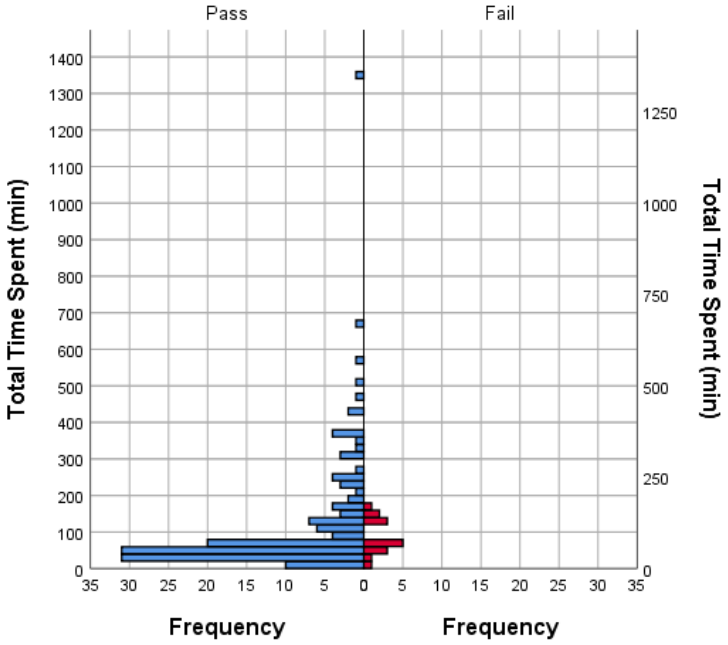
Figure 3. Comparison of NPT score between students who passed or failed the LANTITE based on NPT score categories.

	First Score		Last Score		Lowest Score		Highest Score		Average Score	
	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
Median	29	11	32	20	24	0.5	33	27	27.88	14.75
IQR	20	23	11	26	29	14	6	10	12.67	9.75
Max	39	27	40	31	38	25	40	31	38.5	28
Min	0	0	0	0	0	0	1	1	1	1
Sig.	p<0.0001		p<0.0001		p<0.0001		p<0.0001		p<0.0001	

Table 4. Summary statistics of NPT score categories.

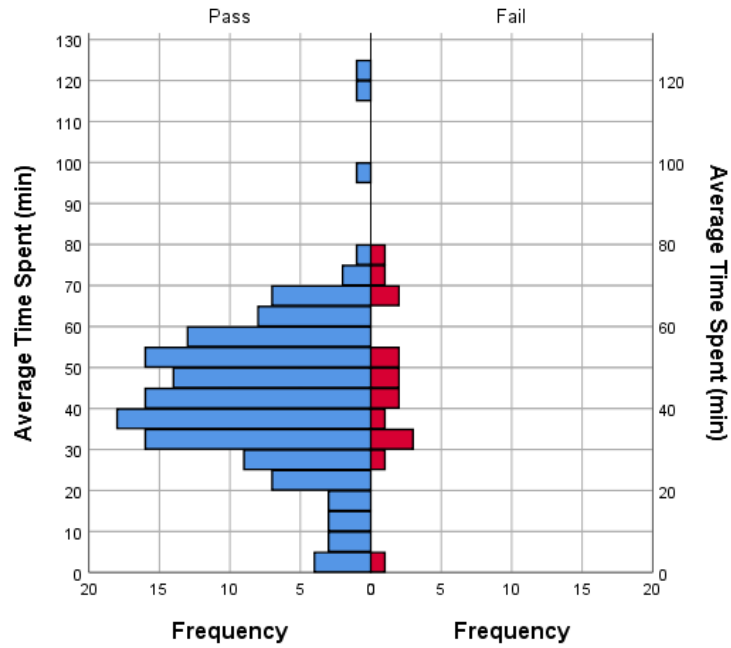
Further, we evaluated the total time students spent on the NPT by combining the duration of all their attempts in order to determine the level of engagement students had with the NPT. As shown in Figure 4A, there was a wider spread in total time spent by students who passed compared to students who failed. Students who passed spent up to 665 minutes (an extreme outlier spent up to 1360 minutes) on the NPT, compared to students who failed only spending at most 163 min in total time on the NPT. Analysis of students' average time for each attempt showed a similar duration spent by both group of students, mostly between 20-70 minutes (Fig. 4B). Although there is greater variability, students who passed the LANTITE spent less time using the NPT, both in terms of the median total amount of time (56.4 vs 71.3 min) and the median average duration of attempts (42.5 vs 44.6 min) (Fig. 4).

A



	Pass	Fail
Median	56.4	71.3
IQR	95.1	91.9
Max	1359.6	163.1
Min	2.2	1.2

B



	Pass	Fail
Median	42.5	44.6
IQR	22.0	32.4
Max	124.8	75.2
Min	2.2	1.2

Figure 4. Students' engagement with the NPT based on their total time spent (A) or average time spent per attempt (B).

To determine the impact the NPT had on preparing students for the LANTITE, we also assessed the number of days between students' last attempt of the NPT and the date that they sat the LANTITE. There was a similar percentage of students who attempted the NPT on the day of the LANTITE (19%), regardless of whether they passed or failed the LANTITE. Students who passed were more likely to attempt the NPT between 1-4 days before the LANTITE compared to those that failed (69.9% vs 50%) (Tab. 5). In other words, students who failed the LANTITE tended to have a longer gap between their last NPT attempt and the

LANTITE. The median days between the last NPT attempt and the LANTITE for students who passed was 1 day compared to 3.5 days for students who failed the LANTITE.

	Pass			Fail		
Days	N	Percent	Cumulative Percent	N	Percent	Cumulative Percent
0	27	18.9	18.9	3	18.8	18.8
1	56	39.2	58.0	4	25.0	43.8
2	10	7.0	65.0	1	6.3	50.0
3	4	2.8	67.8	0	0	50.0
4	3	2.1	69.9	0	0	50.0
5	2	1.4	71.3	2	12.5	62.5
6	4	2.8	74.1	1	6.3	68.8
7	3	2.1	76.2	1	6.3	75.0
8-14	11	7.7	83.9	0	0	75.0
15-21	4	2.8	86.7	0	0	75.0
22-30	4	2.8	89.5	0	0	75.0
31-90	9	6.3	95.8	2	12.5	87.5
>90	6	4.2	100	2	12.5	100
Total	143	100	-	16	100	-

Table 5. Number of days between students' last NPT attempt and LANTITE.

Discussion and Conclusion

To ensure that teaching graduates have personal literacy and numeracy levels equivalent to the top 30% of Australian adults, a standardised test for TES known as the LANTITE was introduced by the Australian Government in 2016 (ACER, 2016). Given the high-stakes nature of the test and since there are currently limited resources available for TES to use to study for the test, we developed in-house an online NPT to support TES' preparation for the numeracy component of the LANTITE.

In this study, we showed that students who passed the numeracy component of the LANTITE achieved a significantly higher score in the NPT than students who failed, based on all five Blackboard measures of overall performance – students' first score, last score, lowest score, highest score and average score (Fig. 3 & Tab. 3, $p<0.0001$ for all five categories). To our knowledge, this is the very first time research has been conducted to evaluate the characteristics of TES who are likely to pass or fail the mathematics or numeracy component of any TES' standardised test, in Australia or internationally. Our finding suggests that it may be possible to identify TES who are likely to pass or fail the test via an online diagnostic test. This finding has major implications for initial teacher education providers globally. For example, targeted and timely support could be provided to TES who are likely to fail the test.

Surprisingly, students who passed the numeracy component of the LANTITE had less engagement with the NPT overall. In particular, students who passed had fewer attempts and spent less time on the NPT. The latter measure of engagement included both total time spent on the NPT and the duration of each attempt (Fig. 1 & 4). Students who passed were also

more likely to have their last attempt of the NPT closer to the date of the LANTITE (Tab. 5). Although this means students who passed had a shorter duration between the NPT and the LANTITE, the fact that approximately 45% of these students only had one attempt at the NPT indicated that a large proportion of students had their first and only attempt of the NPT a few days away from the LANTITE.

Given the high-stakes nature of the LANTITE, the lack of preparation by students who passed the numeracy component of the LANTITE is unexpected. Our observation that TES who passed the numeracy component of the LANTITE are spending less time preparing by using the NPT aligns with the work of others. In particular, studies have found that TES in the US had little to no preparation for the Praxis I: Pre-Professional Skills Tests (Wilder & Stricker, 1998) and as many as 31% of students admitted to not preparing at all (Gordon S. Black Corporation, 1996).

In a study to understand why TES in the US do not prepare for the Pre-Professional Skills Tests, Stricker and Wilder (2002) found that TES who self-reported being confident about the test were the least likely to prepare. In addition, test-takers thought that preparing for the test was unnecessary because the test was easy; their peers shared this belief and also did little preparation. TES were sometimes unaware of the available preparation resources, could not find resources or simply inexperienced and thought it was impossible to prepare for the test. On the other hand, the money and time required for preparation were found to have little to no impact on students' preparation (Stricker & Wilder, 2002).

It is unlikely that students at our institution are unaware of the NPT since students are encouraged to use it at several points in their program. This includes during the induction at the start of their studies, in their second year as part of a mathematics curriculum and pedagogy unit, in multiple professional experience placement workshops and in the fourth/final year, since passing the LANTITE is a pre-requisite for the final placement. Despite this extensive encouragement, only 5% of TES at the institution attempted the NPT, which would suggest that there are other factors preventing students from using it. For example, students may be preparing for the LANTITE through other means.

Another possibility is that TES at our institution, like students in the US, were equally confident about passing the LANTITE and did not feel the need to spend the time and effort to prepare. This would explain our observation that 74.8% of students in this study had only 1-3 attempts of the NPT (Tab. 3). When students attempted the NPT, those who achieved a good result received the affirmation that they would do equally well in the LANTITE and therefore did not need more preparation, especially since students are not given a score in the LANTITE and are only informed whether they have met the standard or not (i.e., pass or fail).

Our observation that students who failed the LANTITE are spending more time preparing and are having more attempts on the NPT compared to students who passed the LANTITE (who spent less time and had fewer attempts on the NPT) suggests that many TES possess good self-efficacy and are able to self-assess the level of support required. This notion is supported by our previous finding that more than 75% of TES who attempted the NPT multiple times achieved their personal best in their penultimate or final attempt (Thai et al., 2019). Indeed, past studies have reported that high test-scorers exhibit more self-regulatory strategies such as setting goals, planning and the ability to seek assistance when required (Kitsantas, 2002).

A potential limitation of this study is the possibility that students used a calculator in the non-calculator section of the NPT. Although students were instructed not to use a calculator in the non-calculator section, it was not possible to know whether students followed this instruction. It must be considered that students may have used a calculator in this section and therefore, results for some students may be higher than their actual ability.

Another limitation of this study is the fact that each test varied in difficulty. The quiz feature on Blackboard randomly selects a set number of questions from each pool, which could vary in ACSF level. Therefore, students could have attempted the NPT at varying levels of difficulty. The variability of test difficulties should be considered when making meaningful decisions about the comparison between NPT scores. The impact of test difficulty is minimised by the relatively high n-value and comparing median scores. Furthermore, it should also be considered that students' subsequent attempts may have included questions they had seen before. It is possible that students may have memorised solutions given in the feedback to answer these repeated questions. However, given the volume of questions in the pool, the difficulty of memorising multiple solutions from a test and that this is an optional diagnostic test designed to help TES prepare for the LANTITE, this is unlikely to be the case. Normalising the NPT scores between attempts is an area for further investigation.

Recently, it was reported that secondary TES with a mathematics focus are likely to score higher in the LANTITE and that primary TES are more likely to score lower (Hall & Zmood, 2019). Hall and Zmood (2019) also found that students generally performed best in the S&P content area and that scores in the non-calculator section were lower than the calculator section. Therefore, further studies should also assess NPT scores based on TES' program of study, mathematics content area and whether the questions were for the calculator or non-calculator section.

Taken together, our findings in this study show that TES who passed the numeracy section of the LANTITE are likely to out-perform students who failed in a similarly designed diagnostic test despite these higher-scorers spending less time on the diagnostic test. This has major implications for institutions looking to develop their own diagnostic test as a way to prepare TES for the LANTITE and/or to identify students who are at-risk of failing the LANTITE.

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